REMARKS

I. Introduction

Claims 14 to 16, 19, 20 and 26 to 35 are currently pending in the present application. In view of the foregoing amendments and the following remarks, it is respectfully submitted that all of the presently pending claims are allowable, and reconsideration is respectfully requested.

II. Objections to Claims 27 and 28

Claims 27 and 28 were objected to due to certain alleged informalities. Applicant respectfully submit that claims 27 and 28, as amended, overcome the present objections to claims 27 and 28. Therefore, withdrawal of the objections to claims 27 and 28 is respectfully requested.

III. Rejection of Claims 14 to 16, 19, 20, 26 to 28 and 32 to 35 Under 35 U.S.C. § 103(a)

Claims 14 to 16, 19, 20, 26 to 28 and 32 to 35 were rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of U.S. Patent No. 5,850,735 ("Araki et al.") and U.S. Patent No. 5,114,691 ("Pinnavaia et al."). Applicants respectfully submit that the combination of Araki et al. and Pinnavaia et al. does not render claims 14 to 16, 19, 20, 26 to 28 and 32 to 35 unpatentable for the following reasons.

Claim 14 relates to an emission control system including a particle filter and an arrangement disposed upstream from the particle filter configured to at least reduce clogging of the particle filter by prevention of development of at least one of zinc-, alkaline- and earth alkaline-containing sulfate ash upstream from the particle filter by one of transformation and maintenance of at least one of the compounds responsible for sulfate ash formation in the gaseous state. Claim 14 recites that the arrangement includes a device configured to collect at least a portion of the sulfate ash-forming compounds contained in the exhaust gas and a device configured to convert the collected sulfate ash-forming compounds into gaseous compounds of sulfur that do not form sulfate ash.

Claim 32 relates to a method for operating an emission control system including a particle filter and an arrangement disposed upstream from the filter and configured to at least reduce clogging of the particle filter by prevention of

development of at least one of zinc-, alkaline- and earth alkaline-containing sulfate ash upstream from the particle filter. Claim 32 recites the step of maintaining at least a portion of the compounds responsible for the sulfate ash formation in a gaseous state. Claim 32 further recites collecting at least a portion of the sulfate ash-forming compounds contained in the exhaust gas and converting the collected sulfate ash-forming compounds into gaseous compounds of sulfur that do not form sulfate ash.

Claim 35 relates to an emission control system including a particle filter and an arrangement disposed upstream from the particle filter. Claim 35 recites that the arrangement is configured to at least reduce clogging of the particle filter by prevention of development of at least one of zinc-, alkaline- and earth alkaline-containing sulfate ash upstream from the particle filter by transforming or maintaining at least one of the compounds being responsible for the sulfate ash formation in the gaseous state. Claim 35 further recites that the arrangement includes means for collecting at least a portion of the sulfate ash-forming compounds contained in the exhaust gas and means for converting the collected sulfate ash-forming compounds into gaseous compounds of sulfur that do not form sulfate ash.

Araki et al. purport to relate to a method for purifying exhaust gas of an internal combustion engine. As shown in Figure 9, the nozzle 7a of the secondary fuel supply unit 7, an oxidizing catalyst 91 and a DPF (diesel particulate filter) 93 are stated to be disposed in the exhaust gas passage 3 from the upstream side in this order. See col. 15, lines 19 to 24. Araki et al. state that a diesel particulate filter ("DPF") 93 is used to filter soot (carbon particles) in the exhaust gas and also as a sulfate absorbent. See col. 15, lines 34 to 38. The DPF 93 is stated to have porous walls, which collect the soot, and numerous internal gas passages coated with alumina, silica or titania, which absorb sulfate. See col. 15, lines 52 to 59.

Pinnavaia et al. purportedly relate to a process using sorbents for the removal of SOx from flue gas. Pinnavaia et al. state that zinc and earth metals like Mg and related substances adsorb Sox, whereby sulfate ash is formed. See col. 1, lines 36 to 39 and 57 to 59. In order to prevent emission of SOx from coal-fired power plants Pinnavaia et al. describe the injection of special sorbents (Mg-containing LDH) into the SOx-containing exhaust gas, either into the boiler or into the filter device of the power plant. See col. 6, lines 23 to 29. This leads, as

intended, to the formation of sulfate ash in the exhaust gas. Therefore, Pinnavaia et al. describe ***enhancing*** the formation of earth alkaline-containing sulfate ash upstream of a filter.

Nowhere does the combination of Araki et al. and Pinnavaia et al. disclose, or even suggest, an arrangement disposed ***upstream*** from the particle filter configured to at least ***reduce*** clogging of the particle filter by prevention of development of ash upstream from the particle filter by transforming or maintaining at least one of the compounds being responsible for the ash formation in the gaseous state, as recited in claims 14, 32 and 35. Given that the DPF 93 is specifically stated to include porous filter walls coated with a sulfate absorbent, i.e., have an ***integrated*** filter and sulfate absorbent, it is respectfully submitted that Araki et al. do not disclose an arrangement, as recited in claims 14, 32 and 35, disposed ***upstream*** from the particle filter. In fact, the combination of Araki et al. and Pinnavaia et al. teach away from the claimed invention. As indicated above, Araki et al. promote the formation of sulfate on the filter and Pinnavaia et al. inject special sorbent to enhance the formation of earth alkaline-containing sulfate ash upstream of the filter. Therefore, the combination of Araki et al. and Pinnavaia et al. does not disclose all of the limitations of claims 14, 32 and 35.

In rejecting a claim under 35 U.S.C. § 103(a), the Examiner bears the initial burden of presenting a prima facie case of obviousness. *In re Rijckaert*, 9 F.3d 1531, 1532, 28 U.S.P.Q.2d 1955, 1956 (Fed. Cir. 1993). To establish prima facie obviousness, three criteria must be satisfied. First, there must be some suggestion or motivation to modify or combine reference teachings. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988). This teaching or suggestion to make the claimed combination must be found in the prior art and not based on the application disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991). Second, there must be a reasonable expectation of success. *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 U.S.P.Q. 375 (Fed. Cir. 1986). Third, the prior art reference(s) must teach or suggest all of the claim limitations. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974). As stated above, the combination of Araki et al. and Pinnavaia et al. does not disclose, or even suggest, an arrangement disposed ***upstream*** from the particle filter that is configured to at least reduce clogging of the particle filter by prevention of development of ash upstream from the particle filter by transforming or maintaining at least one of the compounds

being responsible for the ash formation in the gaseous state, as recited in independent claims 14, 32 and 35. It is therefore respectfully submitted that the combination of Araki et al. and Pinnavaia et al. does not render obvious claims 14, 32 and 35.

Particle filters for combustion engines are generally used to remove ***soot*** from exhaust gas. However, solid ***ash*** contained in the exhaust gas is also filtered and causes increasing and irreversible clogging of the filter. This leads to lifetime reduction of the particle filter, and therefore, is undesirable. Ash is generally composed of sulfates of metals like zinc, alkaline or earth alkaline (sulfate ash) and is formed in the exhaust gas upstream of the filter by chemical reaction of these metals in particular with SO_3.

The system and method presently claimed is based on the reduction of clogging of the filter by preventing the formation of ***ash compounds***. This is accomplished by transforming or maintaining at least one of the reaction partners of the ash-forming reaction in the gaseous state. The arrangement for realizing this, is disposed upstream form the filter and includes firstly a device that is configured to collect a portion of the sulfate ash-forming compounds. That is, one of the ash-forming reaction partners is removed from the exhaust gas upstream from the filter and consequently the other reaction partner is maintained in a gaseous state and is able to pass the filter. Secondly, the arrangement includes a device configured to convert the collected sulfate ash-forming compounds into gaseous compounds of sulfur that do not form sulfate ash. Consequently, the previously collected ash-forming compound is transformed into a harmless compound with respect to ash formation, and therefore, is able to pass the filter. Since Araki et al. do not disclose, or even suggest, collecting sulfate ash-forming compounds upstream of the filter and since Pinnavaia et al. describe enhancing the formation of earth alkaline-containing sulfate ash upstream of a filter, the combination of Araki et al. and Pinnavaia et al. does not disclose, or even suggest, a device upstream from the filter configured to collect sulfate ash-forming compounds into gaseous compounds of sulfur that do not form sulfate ash, as recited in claims 14, 32 and 35.

The Office Action alleges that Araki et al. disclose a particle filter (93) and an arrangement disposed upstream of the particle filter (93). See Office Action at p. 3. The Office Action further alleges that the arrangement includes a device including coating layers of alumina on the surface wall of the exhaust gas passages

of the filter 93. See Office Action at p. 3. Respectfully, the arrangement, stated to be disposed upstream of the particle filter (93), cannot be, as alleged, the particle filter (93) itself or parts of the particle filter, i.e., coating layers of alumina. Applicants respectfully submit that a device cannot be upstream of itself.

The Office Action specifically alleges that DPF 93 may be considered "a device (coating layers of alumina on the surface wall of the exhaust gas passages of the filter(93)) configured to collect at least a portion of the sulfate ash-forming compounds of sulfur in the exhaust gas (during a lean operation of the engine, SOx in the exhaust gas is oxidized by the device to form ash-forming compounds (SO_3 and SO_4)) of sulfur." Office Action at p. 3. Again, the Office Action completely ignores the requirement that the "device" is recited in claims 14, 32 and 35 as being ***upstream*** of the filter. As indicated above, given the fact that the DPF 93 of Araki et al. is stated to include porous filter walls coated with a sulfate absorbent, the sulfate absorbent of Araki et al. DPF 93 is not and could not be considered to be upstream of the filter or DPF 93. Nor does the combination of Araki et al. and Pinnavaia et al. disclose, or even suggest, a separate sulfate absorbent upstream of the DPF 93. Therefore, the combination of Araki et al. and Pinnavaia et al. does not render obvious claims 14, 32 and 35.

The Office Action further alleges that the oxidation catalyst 91 may be considered "a device (91) configured to convert the collected sulfate ash-forming compounds of sulfur into gaseous compounds of sulfur that do not form ash (the oxidation catalyst (91) oxidizes the rich components in the exhaust gas so that the oxygen level in the exhaust gas is reduced and the temperature of the exhaust gas is raised to a level sufficiently high to maximize the transformation of the collected (SO_3 and SO_4) into gaseous compounds (SO_2) of Sulfur (also see the Abstract))." Office Action at pp. 3 to 4. Applicants respectfully traverse the Office Action's allegation that an oxidation catalyst converts ash-forming compounds of sulfur into gaseous compounds of sulfur ***that do not form ash*** and respectfully submit that nowhere does the combination of Araki et al. and Pinnavaia et al. disclose, or even suggest, a device configured to convert collected ash-forming compounds of sulfur into gaseous compounds of sulfur that do not form ash, as recited in claims 14, 32 and 35. As stated in the present application at page 2, lines 17 to 23 of the Specification:

> The exhaust coming from the engine contains sulfur compounds, e.g., 98% SO_2, 2% SO_3 and Ca, Fe, Mg, Zn and P. At temperatures above 350°C, sulfate forms in oxidation catalyst 1, where SO_2 and SO_3 are converted into SO_4. Ash, such as $CaSO_4$, $ZNSO_4$, $MgSO_4$, CaO, FeO, etc., develops downstream from oxidation catalyst 1. This ash collects in particle filter 2 and clogs it. (emphasis added).

It is conventional that an oxidation catalyst not only oxidizes SOF, HC and CO (col. 6, lines 55 to 57 and col. 9, lines 27 to 30) but also oxidizes SO_2 into SO_3, which is a gaseous compound of sulfur that forms sulfur ash. Further, Araki et al. disclose the promotion of adsorption of SOx and the formation of sulfate on the filter wall, i.e., filter clogging, by means of a sulfate adsorbent coated on the filter wall. See col. 15, lines 54 to 66. Sulfate formation is stated to be intensified by platinum -- an oxidation catalyst -- present in the coating. In col. 15, lines 60 to 66 it is clearly stated that the filter itself in addition to soot collects sulfates which necessarily leads to filter clogging. Therefore, a sulfate ash-forming compound (SOx) is collected within the filter, whereas in the subject matter according to claims 14, 32 and 35, sulfate ash-forming compounds are collected upstream of the filter before they can reach the latter, whereby clogging of the filter is reduced. Therefore, it is respectfully requested pursuant to 37 C.F.R. § 1.104(d)(2) that the Examiner provide an affidavit and/or that the Examiner provide published information concerning his assertion that an oxidation catalyst converts ash-forming compounds of sulfur into gaseous compounds of sulfur ***that do not form ash***. This is because this rejection is apparently being based on assertions that draw on facts within the personal knowledge of the Examiner, since no support was provided for these otherwise conclusory and unsupported assertions. (See also M.P.E.P. § 2144.03).

Accordingly, there is no evidence that the references relied upon, whether taken alone, combined or modified, would provide the features and benefits of claims 14, 32 and 35 herein. It is therefore respectfully submitted that claims 14, 32 and 35 are allowable for these reasons. Therefore, withdrawal of the 35 U.S.C. §103 (a) rejection and allowance of claims 14, 32 and 35 are respectfully requested.

As for claims 15, 16, 19, 20 and 26 to 28, which ultimately depend from claim 14 and therefore include all of the limitations of claim 14, it is respectfully

submitted that the combination of Araki et al. and Pinnavaia et al. does not render obvious these dependent claims for at least the same reasons given above in support of the patentability of claim 14. *In re Fine*, *supra* (any dependent claim that depends from a non-obvious independent claim is non-obvious).

As for claims 33 and 34, which ultimately depend from claim 32 and therefore include all of the limitations of claim 32, it is respectfully submitted that the combination of Araki et al. and Pinnavaia et al. does not render obvious these dependent claims for at least the same reasons given above in support of the patentability of claim 32. *Id.*

In view of all of the foregoing, it is respectfully submitted that the combination of Araki et al. and Pinnavaia et al. does not render unpatentable the present claims. Withdrawal of this rejection is therefore respectfully requested.

IV. Rejection of Claims 29 to 31 Under 35 U.S.C. §103(a)

Claims 29 to 31 were rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of Araki et al., Pinnavaia et al. and U.S. Patent No. 6,233,927 ("Hirota et al."). Applicants respectfully submit that claims 29 to 31 are not rendered unpatentable by the combination of Araki et al., Pinnavaia et al. and Hirota et al. for the following reasons.

Claims 29 to 31 ultimately depend from claim 14 and therefore include at least all of the limitations of claim 14. Therefore, Applicants respectfully submit that the combination of Araki et al., Pinnavaia et al. and Hirota et al. does not render obvious claims 29 to 31 for at least the reasons submitted above with respect to claim 14. Specifically, Applicants respectfully submit that the combination of Araki et al., Pinnavaia et al. and Hirota et al. does not disclose, or even suggest, an arrangement disposed ***upstream*** from the particle filter that is configured to at least reduce clogging of the particle filter by prevention of development of ash upstream from the particle filter by transforming or maintaining at least one of the compounds being responsible for the ash formation in the gaseous state, as recited in claim 14.

The Office Action admits that the combination of Araki et al., Pinnavaia et al. and Hirota et al. does not disclose that the arrangement includes a NOx collector but alleges that "it would have been obvious to one having ordinary skill in the art at the time of the invention was made to have utilized the NOx collector taught by Hirota et al. in the modified system of Araki et al., since the use thereof

would have reduced the emission of harmful NOx gas into the atmosphere." Office Action at p. 5. Applicants respectfully disagree and submit that Hirota et al. do not cure the above admitted deficiencies of Araki et al. and Pinnavaia et al. for the following reasons.

Hirota et al. purport to describe an exhaust gas purification device including a trapping element arranged in the exhaust passage upstream of the NOx absorbent for trapping particulates and a processing element for processing the particulates trapped in the trapping element to regenerate the trapping element. Abstract. Therefore, the NOx absorbent is ***downstream*** of the processing element or filter. Hirota et al. further state that the gas purification device includes a preventing element for preventing the exhaust gas from flowing into the NOx absorbent from the trapping element. Abstract. Accordingly, nowhere does the combination of Araki et al., Pinnavaia et al. and Hirota et al. disclose, or even suggest, an arrangement, including a NOx collector, disposed ***upstream*** from a particle filter that is configured to at least reduce clogging of the particle filter by prevention of development of ash upstream from the particle filter by transforming or maintaining at least one of the compounds being responsible for the ash formation in the gaseous state, as recited in claim 14. Therefore, it is respectfully submitted that the combination of Araki et al., Pinnavaia et al. and Hirota et al. does not render obvious claims 29 to 31. Accordingly, withdrawal of the 35 U.S.C. § 103 (a) rejection of claims 29 to 31 is respectfully requested.

V. Conclusion

It is therefore respectfully submitted that the presently pending claims are allowable. All issues raised by the Examiner having been addressed, an early and favorable action on the merits is earnestly solicited.

Respectfully submitted,

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Dated: March 23, 2004 By: _____

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